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Research Article

Review on Power Electronics in Systems for the Production of Renewable Energy

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Abstract: In this paper Multi-Source Renewable Distributed Energy Generation (MRDEG), where different renewable energy generation (non-conventional) schemes and their interconnections for the future are discussed. The main purpose of MRDEG is to connect the energy sources to generate & fulfill power requirement other than the present fashion. Due to increased attention towards clean and sustainable energy, distributed energy systems are gaining popularity all over the world. Power electronics are an integral part of these energy systems being able to convert generated electricity into consumer usable and utility compatible forms. Power electronics is having blended use in renewable energy in wind and photovoltaic system. Power electronics is now developing in the area of efficiency and reduction of installation cost. Wind turbine now uses inverter with improved efficiency and regulation. The PV modules are divided into strings each generating sufficiently high voltage for avoiding amplification. String are connected in parallel through diodes initially line commutated inverter using thyristors were used but has poor harmonics performance. So one or two string of crystalline module are connected to each inverter which has own MPP tracker controller and power losses are reduced.

Keywords: Power Electronics, Photovoltaic System, Inverter, Renewable Energy,

INTRODUCTION

The cost of renewable energy is reducing day by day and its demand is gradually increasing. Most of the power electronics application is in solar and wind energy. Most of the system used in such application produces DC current. For this inverters are required to convert this into AC. There are two types of photovoltaic system: Stand alone and Grid connected. Stand alone connection is used in remote location and grid connected system inject power to utility grid. Power electronics is a ripe area for reducing wasted energy. Data center operators billions of dollars a year on electricity so a significant reduction in wasted energy, which manifests itself as heat, could yield significant savings. To improve efficiency, some data and telecom center operators use direct current power distribution equipment to reduce losses from switching between alternating current from the grid to the direct current used by servers. Advanced power conversion techniques could improve efficiency in many other areas, including LED lighting, solar panels and charging electric cars. Many nations count on coal, oil and natural gas to supply most of their energy needs, but reliance on fossil fuels presents a big problem. Fossil fuels are a finite resource. Eventually, the world will run out of fossil fuels, or it will become too expensive to retrieve those that remain. Fossil fuels also cause air, water and soil pollution, and produce greenhouse gases that contribute to global warming.

Renewable energy resources, such as wind, solar and hydropower, offer clean alternatives to fossil fuels. They produce little or no pollution or greenhouse gases, and they will never run out.

RENEWABLE ENERGY SOURCES

Solar Energy: The sun is our most powerful source of energy. Sunlight, or solar energy, can be used for heating, lighting and cooling homes and other buildings, generating electricity, water heating, and a variety of industrial processes. Most forms of renewable energy come either directly or indirectly from the sun. For example, heat from the sun causes the wind to blow, contributes to the growth of trees and other plants that are used for biomass energy, and plays an essential role in the cycle of evaporation and precipitation that makes hydropower possible.

Wind Energy: Wind is the movement of air that occurs when warm air rises and cooler air rushes in to replace it. The energy of the wind has been used for centuries to sail ships and drive windmills that grind grain. Today, wind energy is captured by wind turbines and used to generate electricity. The air in our environment moves in many directions. The movement is caused by the temperature difference. Hot air rises while cool air comes down. The air from hot tropical region moves towards the cold polar region. The wind energy can be converted into electricity by using a windmill. The wind rotates the fan on the mill which is connected to a dynamo that generates electricity. This wind electricity can also be utilized to produce hydrogen which is the most important element in Hydrogen economy. Wind energy is the other way to produce hydrogen at a low cost but this energy can be utilized in the areas where the wind energy is easily available. The energy required to produce hydrogen is more than what it releases during its utilization.

Hydropower: Water flowing downstream is a powerful force. Water is a renewable resource, constantly recharged by the global cycle of evaporation and precipitation. The heat of the sun causes water in lakes and oceans to evaporate and form clouds. The water then falls back to Earth as rain or snow, and drains into rivers and streams that flow back to the ocean. Flowing water can be used to power water wheels that drive mechanical processes. And captured by turbines and generators, like those housed at many dams around the world, the energy of flowing water can be used to generate electricity.

Biomass Energy: Biomass has been an important source of energy ever since people first began burning wood to cook food and warm themselves against the winter chill. Wood is still the most common source of biomass energy, but other sources of biomass energy include food crops, grasses and other plants, agricultural and forestry waste and residue, organic components from municipal and industrial wastes, even methane gas harvested from community landfills. Biomass can be used to produce electricity and as fuel for transportation, or to manufacture products that would otherwise require the use of non-renewable fossil fuels. It is defined as the conversion of biodegradable waste obtained from the organic and inorganic substances into fuel or power. It is an important source of energy used in domestic as well in industrial applications. All such kind of energy sources are used to produce the pollution free atmosphere and healthy and clean surroundings. Several researches show the new trends in the use of biomass productions

Hydrogen: Hydrogen has tremendous potential as a fuel and energy source, but the technology needed to realize that potential is still in the early stages. Hydrogen is the most common element on Earth—for example, water is two-thirds hydrogen—but in nature it is always found in combination with other elements. Once separated from other elements, hydrogen can be used to power vehicles, replace natural gas for heating and cooking, and to generate electricity.

Geothermal Energy: The heat inside the Earth produces steam and hot water that can be used to power generators and produce electricity, or for other applications such as home heating and power generation for industry. Geothermal energy can be drawn from deep underground reservoirs by drilling or from other geothermal reservoirs closer to the surface.

Ocean Energy: The Ocean provides several forms of renewable energy, and each one is driven by different forces. Energy from ocean waves and tides can be harnessed to generate electricity, and ocean thermal energy—from the heat stored in sea water—can also be converted to electricity. Using current technologies, most ocean energy is not cost-effective compared to other renewable energy sources, but the ocean remains and important potential energy source for the future.

Emerging Technology: To conserve and establish the new renewable sources, many countries are trying hard to develop new projects and harness the new renewable forms of energy. These countries are trying to tap the energy from relatively unexplored sectors. Nanomaterials and Hydrogen fuel cell have the advantage of being smaller and portable. Therefore they have many more applications.

Nanomaterials: DOE is also active in research and development of nanotechnology. Nanomaterials, which are of the size of a 10^{-9} of a meter, offer different chemical and physical properties from the same materials in normal form. They can be adopted in new technologies. Nanomaterials have the potential use in making more efficient solar cells and catalysts that can be used in hydrogen-powered fuel cells. Due to small size and excellent conductivity, CNTs (carbon nanotubes), can possibly be used as foundation of future electronic devices. CNT cables could be used to make electricity transmission lines. CNT cables could be used to make electricity transmission lines, which will give us, large performance improvement over present day power lines.

Hydrogen fuel cell: Hydrogen can be used in a fuel cell which basically operates like a battery. The fuel cell consists of two electrodes and an electrolyte. Hydrogen and Oxygen are passed over the electrodes to generate electricity and Water. Hydrogen cells are used in Auto industry. Compressed hydrogen tanks are used to supply the Hydrogen and Oxygen is used from the air directly. There is no pollution caused by hydrogen fuel cell autos and the only emission is water. If the hydrogen fuel cell autos become main stream instead of exception, we can eliminate autos from the global pollution problem.

Hydrogen economy: The hydrogen economy is an energy system of the coming generations in the near future. The hydrogen can be generated using the renewable energy sources which are readily available. One of such sources is the wind energy that is playing the major role in the generation of hydrogen. The hydrogen economy is capable of fulfilling the human needs of the coming generations. The hydrogen being in the most demand needs the technologies for their production, storage, distribution, and utilization.

Hydrogen Production: Several technologies have been developed to produce hydrogen. Some of the ways have been attempted to describe regarding the hydrogen production. Hydrogen is mainly being produced from fossil fuels in refineries or in industries. The fossil fuels which are used for hydrogen production are in the form of coal, crude oil or natural gas. These fuels produce carbon-dioxide gas during their production process. The processes involved are hydro-treating and hydro- cracking. To avoid the emission of carbon-dioxide gas many other technologies are coming up to produce cost effective hydrogen. Water electrolysis is one of the efficient methods to produce hydrogen but it needs electricity which is expensive. If the method of water electrolysis is being used with photovoltaic (PVs) then that would be more suitable as well an effective method. But photovoltaic cells are costly to produce and install so even though highly efficient but not a good alternative.

Hydrogen Storage: After production storage becomes and important issue which needs to be taken care of. Hydrogen can be stored as solid, liquid or gas in the form of glass micro-spheres, chemical hydrides, metal hydrides or cryo-adsorbers. Hydrogen storage in caverns, aquifers are costly and cause loss of gas and pressurized gas storage systems are similar as conventional gas storage systems. Liquid hydrogen storage is being used only in the condition of high need of hydrogen. Metal hydride storage system has an advantage of storing hydrogen in terms of safety aspect. This process requires system set up and the release of heat during the process is another important factor to make this storage system more popular.

Hydrogen Transport and Distribution: Hydrogen transportation by pipeline is up to 200 km from production to utilization sites but for effective transportation high capacity reciprocating compressors are used. The pipelines used for hydrogen transportation requires large diameter and more compression power. Due to low volume of hydrogen and lower pressure losses, less recompression stations are required and that too placed far apart. It has been estimated that transportation of hydrogen is cheaper comparative to electricity transport.

Hydrogen Utilization: The use of hydrogen as a fuel in the internal combustion engines has been found to a great extent. The hydrogen is more efficiently use by 20% in the internal combustion engines. The greater advantage is its more clean that is the use of hydrogen causes less amount of pollution compare to other gasoline engines. Hydrogen use in jet engines and turbines produces the only pollutant nitrogen oxides. Use of hydrogen in biomedical technology is becoming popular in the form of micro steam generator. Catalytic burners in household appliances are coming up with the use of combustion of hydrogen only.

Hydrogen Safety: Every process has its own risks and benefits. Similarly hydrogen can be a risk-full factor if the proper care is not done starting from the process of production until the process of utilization. Hydrogen has the smallest molecule so high tendency to leak through the smaller openings. Also due to low ignition energy of hydrogen the flame becomes nearly invisible and that could be a dangerous issue as it becomes hard to detect if there is a fire. Liquid hydrogen also causes the risk of cold burns. In spite of all the safety hazards hydrogen is still has a very good safety record and is actually a safer fuel than any other gas.

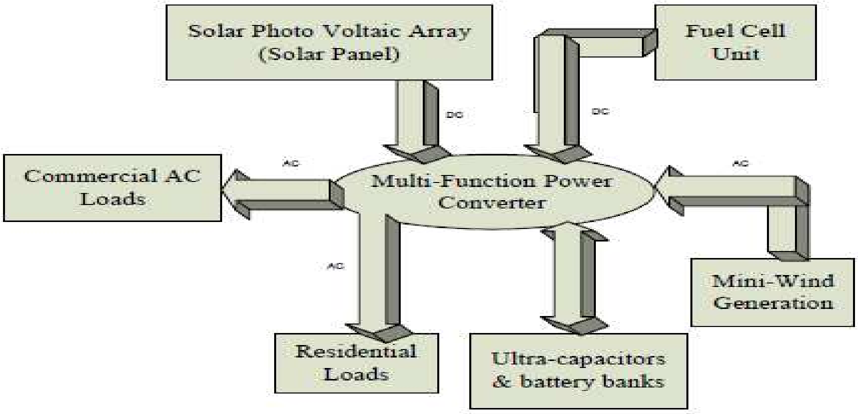

Fig 1: Block diagram of proposed MRDEG system

The solar photovoltaics industry has seen remarkable cost reductions over the past 35 years. PV module prices have declined so much that today *non-module* costs are the majority of total installed cost for utility-scale PV projects. These "balance of system" costs are primed for major reduction through smarter and smaller power electronics, streamlined installation technologies and processes, and project development approaches that leverage low-risk capital and better customer education. Unlike solar and wind power, which have had orders-of-magnitude reduction in cost as experience and manufacturing have scaled, the cost of building a nuclear reactor

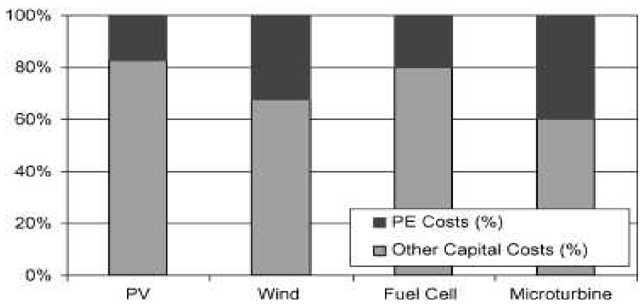

Fig. 2: Power electronics costs compared to total capital costs

has increased over time. A reactor ordered today is 5–8 times more expensive per watt of capacity than a reactor built in the 1970s. Nuclear power plants have a history of major cost overruns and missed deadlines. Of plants whose construction was started prior to 1977, the average actual construction costs were two to three times higher than the average projected cost.

POWER ELECTRONIC IN PHOTOVOLTAIC SYSTEM

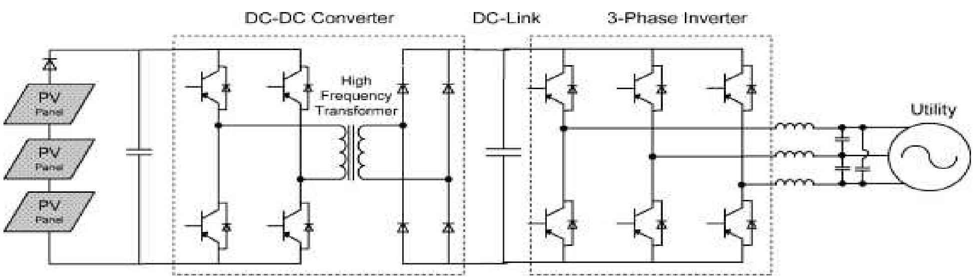

Fig. 3: PV system with high-frequency transformer based isolation.

For the first time, the share of renewable energies in overall power generation within Germany exceeded 20 per cent in 2011. By 2020, this percentage is scheduled to increase to 35 per cent, the German energy transition policy target set after Fukushima. However, because every kilowatt-hour of electricity from wind, water and solar systems is supported by the government through its feed-in tariff policy and the additional costs passed on via the Renewable Energy Sources Act (Erneuerbare Energien Gesetz, EEG) apportionment, the price of electricity will go up. This may be one of the reasons why funding is being cut and expansion capacities capped in the next few years.

A photovoltaic (PV) system consists of solar panels that generate electricity by the direct conversion of the sun's energy into electricity.The solar panels consist mainly of semiconductor material, with Silicon being the most commonly used. The components of a PV system are the solar cells connected in a suitable form and the electronic devices that interface the storage elements and the AC or DC loads. One of the major tasks in controlling photovoltaic cells for power generation is improving cell efficiency and maximizing energy extraction. This requires I-V (current-to-voltage) measurements to characterize performance and determine the load impedance that best matches the cell's source impedance. The best match can then be determined on a point on the I-V curve of the solar cell. At the beginning of 2012 the tariff will only amount to 24,43 ct/kWh. There is however still ways to continue to benefit from the high returns on solar power input. It is possible to build PV systems that are more cost-efficient or improve the efficiency of existing systems, in other words, reduce investment costs and increase returns. The most effective approach is using modern modules with high efficiency and new state-of-the-art technologies such as transformer-based inverters.

An isolation transformer is a transformer used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source, usually for safety. Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected. Isolation transformers block transmission of DC signals from one circuit to the other, but allow AC signals to pass. Suitably designed isolation transformers block interference caused by ground loops. Isolation transformers with electrostatic shields are used for power supplies for sensitive equipment such as computers or laboratory instruments.

Strictly speaking any true transformer, whether used to transfer signals or power, is isolating, as the primary and secondary are not connected by conductors but only by induction. However, only transformers whose *primary* purpose is to isolate circuits are routinely described as isolation transformers. A transformer sold for isolation is often built with special insulation between primary and secondary, and is specified to withstand a high voltage between windings. Sometimes the term is used to emphasize that a device is not an autotransformer whose primary and secondary circuits are connected. Power transformers with specified insulation between primary and secondary are not usually described only as "isolation transformers" unless this is their primary function. Some small transformers are used for isolation in pulse circuits. Isolation transformers are designed with attention to capacitive coupling between the two windings. The capacitance between primary and secondary windings would also couple AC current from the primary to the secondary. A grounded Faraday shield between the primary and the secondary greatly reduces the coupling of common-mode noise. This may be another winding or a metal strip surrounding a winding. The PV module is made of several solar cells which converts the energy of sunlight into electricity (quantum mechanic process) and produces different levels of DC voltage. The commonly used semiconductor material for solar cell is Monocrystalline Si cells, Polycrystalline Si cells and Amorphous Si cell. All PV modules have typical voltage and current characteristic curve [5].

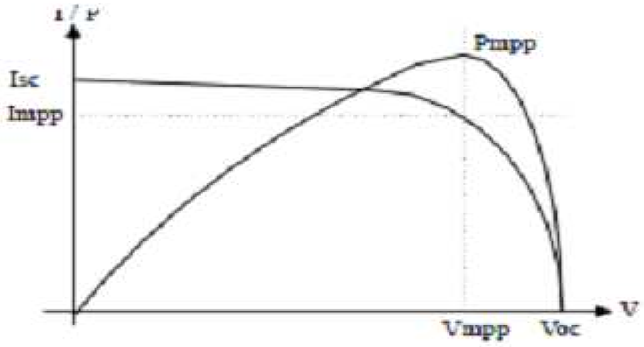

Fig.4: PV module curve

Off Grid PV system are used in standalone connection and uses battery to store energy to cover demand. Where more than one string is used over current protection is required A switch mode DC-DC converter[1, 2] is used to give stable voltage and current characteristic and match the Dc output to the load. It uses either step down converter or step up converter or combination of these two. To maximize the performance of string in most charge regulator, Maximum Power Point Tracker (MPPT) controller is used. It applies Algorithm to track the array voltage which results in Maximum Power. Its efficiency is between 92-97% and its Actual gain depends upon Temperature, Battery charging stare [4, 5]

The input of this Dc to Dc converter is the output of Solar panel string. It converts Dc to high frequency (20-80 KHz) Ac and then back to DC

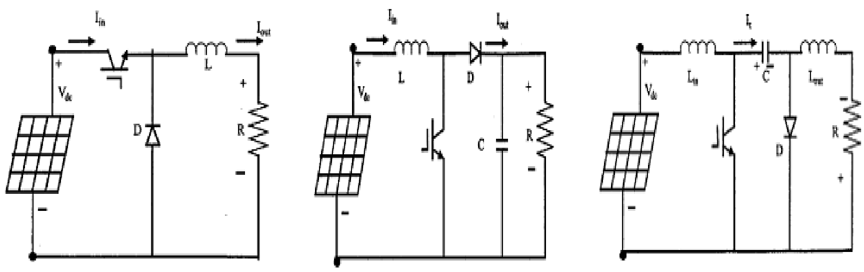

Fig. 5: DC/DC converter techniques

Stand alone PV system uses self commutated inverter producing Ac current without synchronization they produce Ac current same as that of the grid to supply off grid load. MOSFETs and IGBTs based inverter are used in which MOSFET based is used only up to 3KW. Single or three phase inverters are used and SPWM method. The output of inverter is connected to load through transformer .The output voltage is higher if Full wave bridge inverter is used in case of half wave bridge inverter. [4, 5]

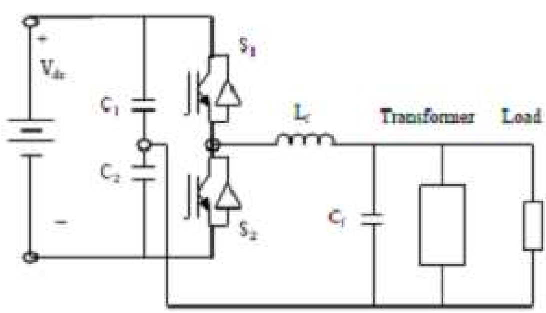

Fig. 6: Single Phase half wave bridge Inverter

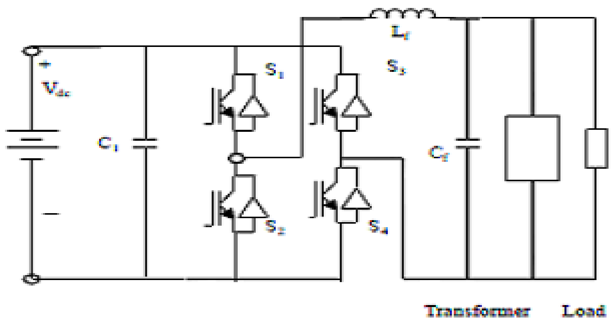

Fig. 7: Single phase full wave bridge Inverter

In grid connected application energy is provided directly to grid It reduces the cost of the system and maintenance. The inverter used in this case has different connection and produces sine wave output, follow the frequency and voltage of grid and obtain maximum power from module and MPPT controller. The most common modulation used is PWM modulation. And operates range from 2-20KHz.Grid connected inverters are VSI or CSI.

The PV modules are divided into strings each generating sufficiently high voltage for avoiding amplification. String are connected in parallel through diodes initially line commutated inverter using thyristors were used but has poor harmonics performance. So one or two string of crystalline module are connected to each inverter which has own MPP tracker controller and power losses are reduced. By this inverter efficiency is increased to 90-92%. Transformer imposes limitation of grid current by inverter. Transformer used is bulky, costly and produce losses so not used commonly. The factors which effect the design optimization are maximum input voltage of inverter and its bandwidth.

IGBTs and MOSFETs with high pulsing frequency provide improved Power Quality with regulation of grid. .The frequency leads to the usage of high frequency transformer with lower weight. This is thus easier in installation and has low transportation cost.

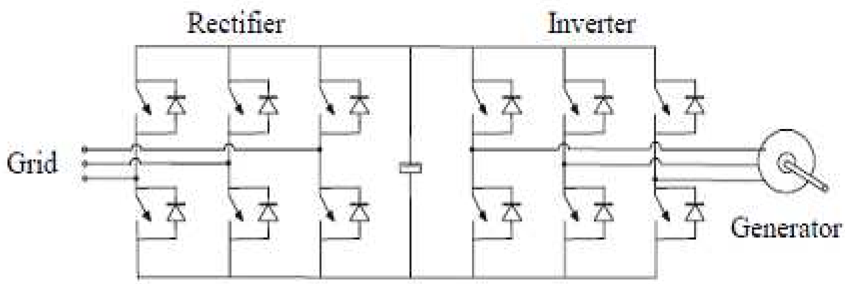

Fig. 8: Back to back PWM VSI Inverter

Now string inverters are available at the range of 2-30 KWp. The three phase string inverters are also in use now days. The multi-string is development in string inverter which is combination of string connected to separate DC/DC converter and then to common DC/AC converter. Each string is controlled individually so it has better performance and efficiency.Stand alone photovoltaic system is the concept of satisfying its own power requirement. A stand alone system is much costly to implement that net zero energy system because of the large requirement of power storage devices that PV modules. Total energy requirement of power meet by using roof top photovoltaic system. Diesel generator sets and micro gas turbines are usually the main source of power supply, In remote isolated areas and arid communities such as small islands. Fossil fuel for electricity generation has several drawbacks: it is costly due to transportation to the remote areas and it causes global warming pollution and green house gases. The need to provide an economical, viable and environmental safe alternative renewable green energy source is very important. As green renewable energy resources such as Photovoltaic (PV) and Fuel Cells have gained great acceptance as a substitute for conventional costly and scare fossil fuel energy resources. Stand-alone renewable green energy is already in operation at many places despite solar and hydrocarbon variations and stochastic nature. Isolated green energy hybrid operation may not be effective or viable in terms of the cost; efficiency and supply reliability unless an effective and robust stabilization of AC-DC interface scheme and maximum energy tracking control strategies are fully implemented. An effective approach is to ensure renewable energy diversity and effective utilization by combining these different renewable energy sources to form a coordinated and hybrid integrated energy system. Integrated green energy system is a valid alternative solution for small scale micro-grid electrification for remote rural and isolated village/island where the utility grid extension is both costly and geographically difficult. Hybrid renewable green energy system incorporates a combination of several diverse renewable energy sources such as photovoltaic, fuel cells and possibly wind, wave energy sources. A system using such diverse combination has the full advantage of supply diversity, capacity and system stability that may offer the strengths of each type. The main objective of integrated green energy scheme is to provide supply security for remote communities. Hybrid integrated green energy systems are also pollution free, and can provide electricity at comparatively viable and economic advantages to Diesel generator set or micro grid using Solar cell/photovoltaic fuel cell utilized in electricity in remote areas. Many people in rural areas in developing countries do not have access to electricity and even electrification of the metropolitan areas and suburbs is incomplete or unreliable. It has been reported that more than 1.6 billion people, mostly in developing countries, do not have access to electricity and that most of them live in rural areas. If one would provide all people on earth with access to electricity by the year 2030 we should realize that the number of new consumers during this coming 23 years will be some 4 billion taking the projected global population growth into account. From this perspective, we have to understand that today just over 4 billion people have access to electricity and that this achievement has taken over 100 years. According to projections of the International Energy Agency the electrification rate in 2030 will be 65% for rural areas and 94% for urban areas (table 1). Today these figures are 60%and 91% respectively. The challenges are enormous, from the technical as well as from the financial and organizational perspective. All need innovation and new ways of thinking; “business as usual” is not applicable.Unfavorable technical conditions (long distances, low load densities, low average loads), limited government resources, and limited ability of customers to pay for electricity characterize rural electrification. These observations induced Cigré to address the subject of electricity supply to rural and remote areas. In 2005 a Cigré Regional Conference and a SC C6 Colloquium in South Africa (Cape Town) addressed problems, difficulties and opportunities in extending electrification in the rural areas of Southern African countries. The outcomes of these events were among the motives that inspired Cigré to establish in autumn of 2006 the international Working Group C6-13 “Rural Electrification”. This Group was assigned the task to specifically address the electrification of rural and remote areas. Measurement of direct solar radiation has been shown to be very useful to improve control performance and disturbance rejection in solar fields by anticipating the effect of sudden changes in solar radiation due to clouds. Since direct solar radiation is measured locally by pyrheliometers, important errors in the estimation of the overall effective solar radiation can be produced when the pyrheliometer is covered by clouds while the rest of the solar field is not or viceversa. Furthermore, estimation of the overall efficiency affected by the reflectivity and absortance of metal tubes is very difficult because only local measurements can be obtained.

POWER ELECTRONICS FOR WIND TURBINE

There are two types of wind turbine: horizontal axis and vertical axis with range from 50W to 7MW.There are three types of wind power system: (i) Stand alone (ii) Hybrid and (iii) Grid type system. Stand alone type is mostly used and uses batteries to store produced energy and inverter to convert AC current. It requires charge regulator which will feed power from wind generator to battery bank in controlled way. It uses permanent magnet generator and charging control is done by controlled rectifiers. The charged regulator must be programmed to limit current in batteries to reduce current when batteries are charged to maintain trickle charge[2][5] The hybrid system includes other renewable sources like PV system Grid connected Wind turbine is connected through power electronics device. There are different types of inverter used such as PWM-VSI converter and matrix converter. The back to back PWM-VSI is bidirectional power converter having two PWM inverters. To obtain full control of grid current DC link voltage is boosted to level higher than amplitude of grid line voltage. The power flow of grid side converter is controlled to keep DC link voltage constant while control of generator is according to magnetization demand and reference speed.

The matrix inverters can effectively convert three phase power output to WT to electrical grid characteristic for proper connection they have array of controlled bidirectional switch to convert AC power from one frequency to another. They produce variable output voltage. They do not posses DC link circuit and do not use large energy storage element. MOSFET for low power and IGBTs for high power enable the implementation of bidirectional switches make inverter easy for power handling.

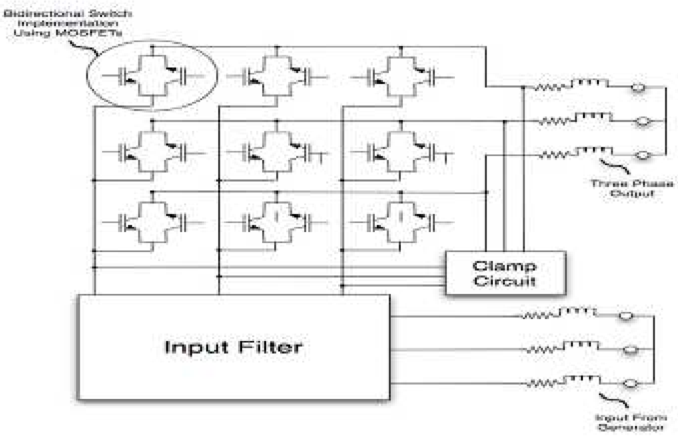

Fig. 9: Matrix converter

Input filter minimizes high frequency component in input current and reduces disturbance of input power. Input filter is designed with combination of L and C with parallel damping resistor and clamp circuit provides overvoltage protection and uses fast recovery diodes.There is duty cycle factor which adjust to regulate ratio of output to input voltage to maximum value. The output is then passed through filter to reduce harmonics. The driving circuit of IGBT is same as of MOSFET and linkage capacitor between IGBT terminals is low. In PWM type rectifier when switching frequency increases power loss becomes high during deactivation of switching element and commutation diode. This case limits the usage of IGBT with 50 KHz as switching element. In high frequency resonant inverters the frequency can be up to 250 KHz.

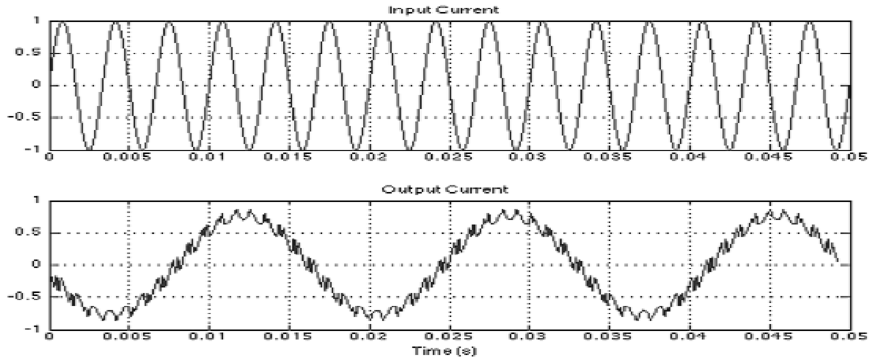

Fig. 10: Matrix converter steady state simulation

Along with matrix converter, the other type used is: (i) Tandem converter (ii) multilevel converter and (iii) Resonant converter. The matrix converter can replace the transformer without the need of high voltage rating .With respect to harmonics reduction the best system to be used is multilevel converter both on the generator and grids side. The resonant converter system is used widely. An example of static converter is switching to grid of wind turbine equipped with induction generator,the direct connection of wind turbine to the can cause high current and torque pulsation. So a soft starter is used to regulate the applied stator voltage of IM. The commutating device has two anti parallel thyristor per phase[1] whose firing angle(α) depends upon power factor of the element which is connected .In case of resistive load 0< α<90 and for purely inductive load 90< α<180.

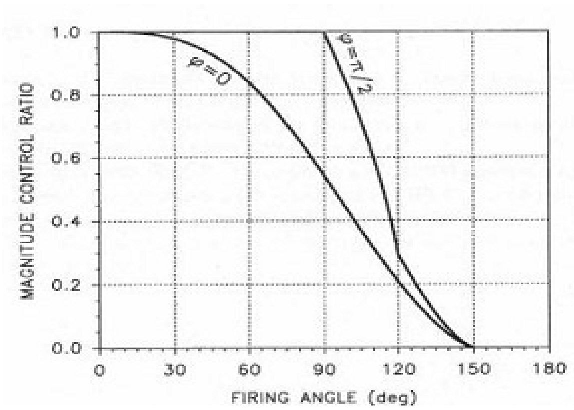

Fig. 11: Controlled characteristic of controlled starter

The turbine accelerates under pitch control to synchronous speed through wind power alone and then switched to grid.

AC controller is connected to grid at zero speed and fast acceleration to operating speed .When generator is connected to grid contractor is used to bypass the starter to reduce the losses.

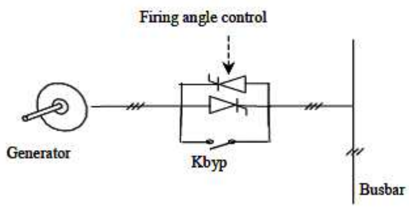

Fig. 12: Soft Controller

USE OF MICRO INVERTER IN RENEWABLE SYSTEM

In commercial application, the component interfaces with photovoltaic panel, batteries that stores charge and the utility grid. A solar inverter takes low voltage from DC output of the array from the PV system and converts into combination of DC battery voltage, AC line voltage and Distribution Grid voltage. In Solar energy harvesting system, multiple solar panels are connected parallel with single Inverter that converts Variable DC output voltage of multiple PV cell into sinusoidal voltage source. Using a micro inverter for individual solar panel using single inverter reduces the different controlling requirement and adjusts the conversion parameter using PWM technique. They manage the energy conversion and improve the system monitoring. The microcontroller is integrated on chip communication peripheral to simplify interfacing with other micro inverter in the solar array. The microcontroller detects the load current and changes the output voltage by turning off the output MOSFET .It has Analog and digital converter to sample out the voltage and current.

FEATURES OF MICROINVERTER BASED PV SYSTEM

It supports the different types of Protocol like PLCs (Power Line Communication). It also has high power PWM capability and posses the advantage of software programmability .It has Integrated Dual on-chip oscillator for clock comparison, multiple high resolutions PWM with interface and communication protocol. In the direct method of energy conversion PVs generate DC output which is converted into AC by Inverter. PV based solar energy has limited distribution and capacity but some facilitate up to 60Mw in recent development. In solar thermal conversion the sun rays directed by mirror heat the thermal exchange agent to high temperature and exchange heat to run steam turbine which is driven by a synchronous Generator. They also store energy and plant has the capacities of several hundred MWs. The storage of energy is done through thermal phase transition.

CONCLUSION

Power electronics are an integral part of these energy systems being able to convert generated electricity into consumer usable and utility compatible forms. In PV system inverter efficiency is continuously increasing and weight is been minimized to reduce transportation and installation cost The power and voltage range of string and inverter is increased so that efficient and cheaper PV installation can be realized using lesser number of inverter. Power Electronics for Wind Turbine system is more efficient control system with more effective converter used now. The extra cost of saving the energy is recovered which reduces consumption and generation that causes environmental pollution and thus reduces global warming. The significance of power electronics is clear in terms of Advancement in inverters; microcontroller and high temperature solid state fuel cell. Environmentally friendly and sustainable alternative energy systems will play more important roles in the future electricity supply. The conclusion obtained from the above is that we should increase the use of renewable sources of energy and decrease the use of non renewable resources.

REFERENCES

1. Muhammad H. Rashid, “Power Electronics Handbook” IEEE, Academic Press, copyright 2011
2. Mohan, Undeland, Robbins, “Power Electronics”2nd edition 1995
3. Papadopoulos Michalis, “Energy Production from renewable energy system application “,copyright 1997

4. Simone Buso and Paolo Mattavelli,"Digital Control in Power Electronics" Morgan and Claypool Publication Copyright 2006
5. I.Fragkiadakis, "Photovoltaic System", Zito Press, copyright 2004
6. Adedamola Omole "Analysis, Modeling and Simulation of Optimal Power Tracking of Multiple-Modules of Paralleled Solar Cell Systems ". Fall Semester, 2006
7. Caisheng Wang, " Thesis on Modeling And Control Of Hybrid Wind/Photovoltaic/Fuel Cell Distributed Generation Systems" July 2006
8. P.Costamagna, S.Srinivasan, "Quantum Jumps in the PEMFC Science and Technology from the 1960s to the Year 2000," Journal of Power Sources, 102:242-252, 2001.
9. H.Chihchiang,S. Chihming,L. Jongrong, "Implementation of a DSP-Controlled PV System with Peak Power Tracking," IEEE Trans. Industrial Electronics, 45(1): (1998), 99-107
10. X.Liu, L.A.C. Lopes, "An Improved Perturbation and Observation Maximum Power Point Tracking Algorithm for PV Arrays," Power Electronics Specialists Conference, June 2004. PP 2005-2010,
11. N.Fernia, G. Petrone, G. Spagnuolo, M. Vitelli, "Optimizing Duty-Cycle Perturbation of P&O MPPT Technique," Power Electronics Specialists Conference, June 2004, 1939-1944,
12. J.Niemann, "Understanding Solar Cell Physics," Sensors, 21(5) (2004), PP 57–62,
13. R.C.Cope, Y. Podrazhansky, "The Art of Battery Charging," Battery Conference on Applications and Advances, January, 1999. PP 233-235
14. L.Castaner, S. Silvestre, "Modeling Photovoltaic Systems," Wiley, 2002
15. F.Z Peng,"Z source Inverter, IEEE(Industry Applications),39, (2003) PP 2
16. P.Boulanger,Malbranche,"Photovoltaic System, Photovoltaic Energy Conversion, 2, (2003) PP 2098-2101
17. J Belcells, J. Dolezal,IEEE Transaction of Industrial applications,4, (2004) PP 3- 31
18. A.J. Gallego, E.F. Camacho, " Estimation of effective solar irradiation using an unscented Kalman filter in a parabolic-trough field", Solar Energy, 86(12) (2012), 3512–3518
19. Jun Zhang, Zheng Wu, Yanmin Jia, Junwu Kan, Guangming Cheng, "Piezoelectric Bimorph Cantilever for Vibration-Producing-Hydrogen" Sensors (Basel), 13(1), (2013), 367–374.

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